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Successful Strategies for Engaging Community Colleges and Universities in Transfer Partnership

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Introduction

In order to increase the number of students (U.S. citizens or permanent residents) receiving associate or baccalaureate degrees in established or emerging fields within science, technology, engineering, and mathematics (STEM), the National Science Foundation (NSF) established the Science, Technology, Engineering, and Mathematics Talent Expansion Program (STEP).

The Student Enrollment and Engagement through Connections (SEEC) project is a collaboration between Iowa State University (ISU) and Des Moines Area Community College (DMACC) funded by a STEP grant to increase the number of students graduating with a bachelor's degree in engineering at ISU and the number of students in pre-engineering study at DMACC.

In this paper, we present the SEEC project goals, conceptual framework, specific project results, and best practices which identify key messages for others developing STEM partnerships. Of the many successful SEEC practices, this paper will focus on four which are foundational to success of CC transfers to engineering. These are: 1) collaboration between institutions, 2) creation of an engineering orientation course at the CC, 3) development of an engineering admissions partnership program, offered by the university for CC students, and 4) data collection and analysis for informed decision making. Program strategies include engaging community college (CC) transfer students while still at the CC, messaging for academic advisors, faculty, and students based upon CC student success data, and the sharing of results of several data briefs which summarize relevant results of a research study on student success. In addition to providing data analysis, the results determine distinctive strategies to increase the success of CC transfers in engineering. Highlights include the creation of a transfer-friendly environment, a community of practice through partnerships, greater awareness about engineering and engineering careers, student-faculty interaction related to educating and training the engineer of 2020, and new datasets for research and evaluation.

The SEEC project was informed in part by research from the National Academy of Engineering (NAE) *Changing the Conversation* report (2008)[1], which reports results of a research-based effort to develop and test new, more effective messages about engineering. The overall conclusion of the report is that the public image of engineering and engineers must appeal to the optimism and aspirations of students and must be all-inclusive. In the past, the image of

engineers has been focused mostly on white males and messages have emphasized the preparation, especially in math and science, necessary for engineering careers. Recently, a NAE report, *Messaging for Engineering: From Research to Action* (2013)[2] supports these efforts by the engineering community to communicate more effectively about the profession and those who practice it. It concluded that to interest young people from all backgrounds, the new messages must cast engineering as inherently creative and concerned with human welfare, as well as emotionally satisfying, thereby appealing to their desire to find hands-on solutions to problems that can make a difference in the world and improve people's lives.

Background

Community colleges are vital to the health of our education-driven economy. As the United States seeks to graduate more engineers and scientists and to expand and diversify its STEM workforce more generally, community colleges (CCs) provide a vital source of students for four-year colleges and universities (American Association of Community Colleges, 2013)[3]. Nearly half of all undergraduate students enroll at a CC sometime during their education (Handel & Williams, 2012)[4]. In Iowa, for the 2010-11 academic year, 56% of all Iowa students who completed a degree at a four-year institution had previously enrolled at a two-year institution (National Student Clearinghouse Research Center, 2012)[5]. Despite the large numbers of new enrollments at four-year institutions that CC students provide, it has been estimated that only 25–35% of CC students actually complete the transfer process (Handel & Williams, 2012)[4]. Community college graduates also have a positive impact on the local and state economy. Students from CCs who complete bachelor's degrees may be more likely to stay in-state once they have finished their education, especially in high-demand fields such as engineering. A SEEC study at Iowa State University (Laugerman & Mickelson, 2011)[6], found that a significantly higher percentage of engineering graduates who transferred from a CC took jobs in-state as compared to non-transfer students.

However, there are "enduring obstacles to transfer" (Mullin, 2012, p. 4)[7] that must be constantly overcome. These include the nonlinear paths that students take through transferring into and out of multiple institutions, dropping out or stopping out, prior college credits, and massive open-online courses (Mullin, 2012b)[8]. Research indicates that, along with other types of support, community colleges would do well to provide more counseling for transfer students (Hagedorn, Moon, Cypers, Maxwell, & Lester, 2006; Laanan, 2007)[9, 10]. Because the process of preparing for transfer and the transition involved is complex, students' chances of transferring and completing a baccalaureate degree are greatly enhanced when two-year and four-year institutions work together to facilitate the process and reduce barriers (Community College Survey of Student Engagement, 2007)[11]. Most importantly, research shows that creating a culture of transfer is the key component in successful transfer partnerships (Kisker, 2007)[12]. Creating a culture of transfer begins with partnerships that can raise students' awareness of the opportunities available to them before, during, and after CC. CCs occupy a unique position that

enables them to work with both high schools and 4-year institutions of higher education. But for a transfer partnership to be successful, participants must work to establish a high degree of trust among institutions and the individuals within them (Kisker, 2007)[12].

One practice with solid evidence that participation increases retention is the creation of learning communities (LCs) (Tinto, 2006, 1997; Taylor, Moore, MacGregor, & Lindblad, 2003; Zhao & Kuh, 2004)[13 14, 15, 16]. LCs at ISU feature (http://www.lc.iastate.edu/whatis.html) small groups of students who generally take one, two, or three courses together and may live in the same residence hall. Other characteristics involve:

- Contact with students who have similar academic goals
- Common courses
- Common place of residence
- Career exploration
- Introduction to university resources
- Peer mentoring and/or tutoring
- Faculty mentoring.

LC data from ISU (http://www.lc.iastate.edu/LC_15yr_success.html) show that, compared to non-LC participants, LC participants' one year retention rates are 8 percentage points higher, average six-year graduation rates are 12 percentage points higher, and overall student satisfaction and engagement is higher. Also, a higher percentage of students of color participate in LCs (76%) than the overall representation of students in LCs (70%).

An important feature of LCs is peer mentoring. Myers, Silliman, Gedde, and Ohland, (2010)[17] summarize literature which shows that first-year students are more comfortable going to upper-class engineering students rather than to faculty to discuss educational topics, consistent with a number of studies demonstrating that informal relationships and mentoring in a variety of organizational contexts is accepted as important to integration and retention (Jacobi, 1991; Ragins, Cotton, & Miller, 2000)[18, 19]. Further, student-student relationships have been recognized as the largest influence on student satisfaction with several college environments, with student-faculty relationships as the second-largest influence (Astin, 1993; Korte & Smith, 2007)[20, 21].

In addition to the other obstacles to an engineering degree, the difficulty of the coursework itself continues to be a major obstacle. Suresh (2006)[22] found that a majority of engineering majors who earned a B-minus or below in Calculus I, Calculus II, and Physics I—strategic "gatekeeper" courses—left engineering. The freshman year model identified grades in Physics I, Calculus I, and Chemistry I as the best predictors of retention. Most students who leave engineering do so before they have successfully completed these difficult courses (Levin & Wyckoff, 1990)[23]. Whalen and Shelley (2010)[24] agree that the single fundamental variable in predicting retention in science, technology, engineering, and mathematics (STEM) fields is grade point average (GPA). They found a dramatic increase in retention and/or graduation achieved by an average increase of

as little as one-tenth of a percentage point in cumulative GPA. This suggests that doing what is necessary to improve grades must be the top priority for retaining engineering students.

The Collaborators

Des Moines Area Community College (DMACC) is a public institution and Iowa's largest two-year college. DMACC offers 153 programs, certificates, and transfer degrees, annually serving more than 75,000 credit and non-credit students at campuses and learning centers throughout Central Iowa. DMACC serves a 6,560 square mile area in 22 counties and has a student to faculty ratio of 18:1.

Iowa State University of Science and Technology, more commonly known as ISU, a flagship university of the Iowa university system, is a public land-grant and space-grant research university located in Ames, Iowa. Founded in 1858 and coeducational from its start, ISU is classified as a Research I University with very high research activity (RU/VH) by the Carnegie Foundation for the Advancement of Teaching. The university is a group member of the American Association of Universities and the Universities Research Association. A record 34,732 students enrolled at ISU in the fall of 2014. The student body includes 27,659 undergraduates, 4,950 graduate students and 592 professional (veterinary medicine) students, 3,980 international students from 101 countries and 4,065 U.S. multicultural students. The Learning Communities (LCs) program, which began in 1995 with 407 participants, now has over 5,000 participants.

SEEC Project Goals

SEEC project connections are rooted in community: LCs, CCs, and Iowa communities. The SEEC project was driven by five distinct teams, each responsible for attaining specific objectives. These practices were developed based on various entry and transition points for students entering the College of Engineering (CoE) at ISU, either direct from high school (DHS) or through transfer. The five areas and corresponding objectives are listed below:

1. Community: Build a learning village that enhances student engagement and creates Iowa State connections for CC pre-engineering transfer students. Retention at DMACC and ISU will be increased by a new LC model, called a learning village or meta-community.
2. Curriculum: Enhance first- and second-year learning experiences, with an emphasis on student success and engagement and classroom climate. First-year and gateway engineering courses are being reviewed to engage students more effectively, to provide flexibility, and to support transfer students.
3. Advising: Develop and enhance academic advising and mentoring programs for precollege, CC, and university students. Student-centered advising is being coordinated to broaden the diversity of students enrolled in engineering and to make

students aware of the various paths to successfully completing an engineering degree, including transfer from a CC. Students are being advised on the range of STEM disciplines.

4. Networking. Establish a recruiting and outreach network across Iowa to tap into diverse communities of students, and to improve the awareness and understanding of engineering among those who influence student choice. With ISU Extension and Outreach, we are seeking to improve the public awareness and understanding of engineering, especially among students and their parents. The methods of the project will serve ISU and DMACC in several contexts and will be adaptable (scalable and portable) to other institutions.
5. Evaluation: We aim to evaluate project effectiveness that will enhance the success of the project. Our methods of evaluation will serve to inform and educate other institutions.

The SEEC project conceptual framework displayed in Figure 1 (Laanan, Rover, Bruning, Mickelson, Shelley, Laugerman, Darrow, & Pontius, 2012)[25] illustrates the progression of a CC student toward a degree in engineering and the relevant SEEC intervention strategies. This model reflects the many variables that may impact the engineering transfer student and illustrates the role of the E-APP in transfer student success.

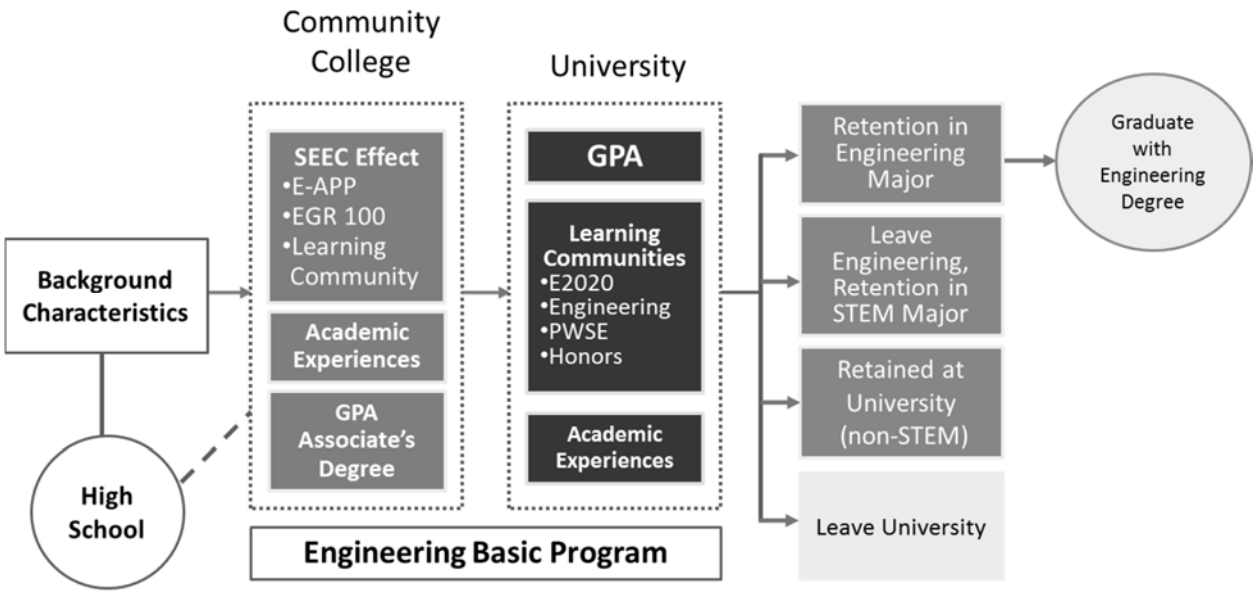

Figure 1. SEEC model conceptual framework

In addition to the E-APP, several programs have been created to address connection-based needs of transfer students. These include Engineering 100 (an engineering orientation seminar course offered at the CC), and LCs offered to students before and after transfer. LCs at the university include The Engineer of 2020 (E2020) Scholars Program in the CoE for first-year and transfer

students who demonstrate academic potential and financial need. Program participants must also be interested in learning about leadership, entrepreneurship, global thinking, and systems thinking within engineering. Other LCs include engineering departmental LCs, the Program for Women in Science and Engineering (PWSE), and the Honors LCs (www.lc.iastate.edu/lc_index.html).

An important result of the SEEC project is a more rigorous data collection and analysis process, as well as systems for monitoring efforts to improve CC transfer student achievement. A major reason for this success was the data sharing that occurred between the institutions, which was initiated by ISU as a result of the SEEC study. The university took greater responsibility, using its larger institutional resources for data collection and management.

Data Briefs

Multiple data briefs are available on the SEEC website which summarize the specific project goals, successful practices, and data analysis results of the project: (http://www.eng.iastate.edu/seec/homepage.html). Some topics that are presented include

1. Retention
2. Engineering Orientation (EGR 100)
3. Engineering Admissions Partnership Program (E-APP)
4. Learning Communities and Retention
5. The "Basic Program"—core engineering course requirements and retention.

The SEEC project research team began collecting and analyzing an extensive amount of data pertaining to Iowa State engineering students. The overall goal of the data collection and analysis was to develop standard reports to help administration make programming decisions at ISU, DMACC, and other Iowa CCs that foster transfer student success in engineering at ISU. Strengthening the pathway to an engineering degree through collaboration and support of transfer will increase both the number of engineering graduates and the diversity of these graduates. CC programs historically have higher representation among underrepresented groups such as female, minority, first-generation, and lower-income students (National Academy of Engineering 2005)[26].

The general retention trends of Iowa CC students entering engineering compared to DHS students indicate that these students are statistically significantly less likely to remain in engineering at ISU. However, data comparing CC students who participated in a LC with those who did not indicate that being part of a LC increases retention. LCs are part of a collaborative, connection-based strategy to increase retention among all student segments, with an emphasis on CC students, and is part of the overall strategy of the SEEC project.

The introduction of the SEEC program correlated with increased success rates for in-state CC transfer students. Before SEEC, CC transfer students left ISU at higher rates than they did

following initiation of the SEEC project. This success was the product of a number of specific components of the project, and our experience with the manner in which these components worked to foster positive outcomes from SEEC provides lessons learned that may benefit other efforts to enhance CC student outcomes post-transfer. Among the best practices recommended (see Figure 1) are the presence of an academic advisor at the four-year institution who works directly with students at the two-year institution, peer mentors at the university, transfer articulation between the institutions, increased connections between the CC and the university which for SEEC included Engineering 100 and LCs offered to students before and after transfer.

EGR 100 provides pre-engineering students with a broad overview of the engineering disciplines and general information about the transfer process to a four-year institution. The course brings in guest speakers from ISU's CoE as well as professionals in industry. Scheduled plant tours give students the opportunity to see engineering in action. Students not only learn about engineering career opportunities, but are given information about internships and experiential learning that they could participate in as students. A guest speaker explains behavioral-based interviewing to help prepare students for their interviews. The class also makes a trip to the ISU Engineering Career Fair each semester. Since its inception:

- The number of pre-engineering students at DMACC increased from 160 at the start of the project to 467, which includes 79 women and 75 under-represented minority (URM) students
- Enrollment in DMACC's introductory engineering course, Engineering 100 (EGR 100), which was created as a SEEC initiative, increased from the 13 students in the first class to 105. This course has been extended to three other DMACC campuses, including an urban campus, with more URM students.
- The DMACC Pre-Engineering program is now available at four sites—the Ankeny, Boone, and Urban campuses, as well as the Ames Hunziker Attendance Center. DMACC began offering engineering orientation and engineering problem solving at the DMACC Urban campus. The Urban campus is the most diverse campus, and addition of a 4th campus for pre-engineering courses will make the courses more accessible, hopefully increasing retention.
- The number of new transfer students received in engineering from Iowa CCs has risen from 100 to 150 since the start of the project.

EGR 100 was originally developed with an emphasis on providing DMACC pre-engineering students who would be transferring to ISU's CoE with information about the transfer process. It now includes more general information about the transfer process to meet the needs of those who will go into engineering at any four-year institution. Broader transfer information includes information about financial aid and ways to finance an engineering education. A course audit is conducted and a graduation plan is created that encompasses both the student's graduation from DMACC and his or her plan for graduation from a four-year institution. Additionally,

information about the differences in culture between DMACC and a four-year institution are discussed to help students make a smoother transition to a larger institution.

The SEEC project has focused on increasing engineering student success through ISU's established LCs as part of a collaborative, connection-based strategy. The project has helped increase the number of engineering LCs among the CoE departments and has helped establish LCs specifically for transfer students, including the Engineering Admissions Partnership Program (E-APP). Statistical analysis of retention data clearly indicates that a student's participation in a LC increases the likelihood that he or she will be retained through the first year. Further analysis shows that transfer students who participate in a LC will be retained at a level near DHS students in LCs and will surpass all those who do not participate. Women who participate in a LC will be retained at a higher level than those who do not participate. It was also discovered that women who participate in two or more LCs are retained at an even higher level. Therefore, it is recommended that ISU's CoE promote LCs to all incoming engineering students and encourage them to participate. Additional efforts should be made to reach transfer students since their overall participation is low compared to DHS participants. Increasing the number of transfer-specific LCs is also recommended, as this has helped boost transfer participation over the past five years. CC students should be encouraged to join E-APP prior to transfer, as this is a transfer-specific LC that connects transfer students to ISU while they are attending a CC. LCs increase students' connections to the CoE at ISU and, as a result, increase one-year retention.

The E-APP was created in 2008 as a SEEC project initiative. E-APP's goal is to increase CC students' engagement prior to coming to ISU and thus increase their retention and graduation rates. These connections include coordinated academic advising, peer mentoring, campus visits, and online social and professional networks. Pre-engineering CC students who sign up for ISU's Admissions Partnership Program (APP) are invited to join the E-APP LC. This virtual LC connects students to ISU's CoE faculty, staff, and students through multiple channels. One of these channels is the E-APP online professional network. This site is moderated by transfer peer mentors—former CC students who transferred into engineering at ISU. Here transfer students connect with each other prior to transfer, as well as meet ISU engineering students, faculty, and staff. Peer mentors offer advice based on experience, answer questions, post information about events, and guide discussions. Students are also apprised of on-campus speakers and other general engineering events through the online professional network. E-APP also hosts events throughout the year to bring transfer students to campus. The effects of E-APP include:

- Enrollment in E-APP increased from 59 to 127 since the start of the project.
- CC transfer students enrolled in E-APP had statistically significantly higher one-year retention rates than non E-APP students.

A quasi-experimental study conducted as part of this project (Laugerman, Shelley, Mickelson, & Rover, 2013) evaluated E-APP, which was designed to improve the navigational success of CC transfer students through connections to the university while still at the CC. The objective of the

study was to determine the efficacy of the E-APP and its interventions, which are measured by increased participation rates and increased university retention rates for E-APP participants. The results show statistically significant improvement in first- year retention rates for E-APP participants. This research may help increase the success of CC transfers to engineering through developing and implementing similar navigational programs.

Academic core coursework common to all ISU engineering majors is called the Basic Program. Earlier research (SEEC Data Brief: Data Collection and Analysis Project—Retention) showed a correlation between academic success in engineering at ISU and grades in Basic Program courses. An engineering CC transfer student has the option of taking any of these courses at the CC (if available) or at ISU. Empirical data about CC transfer students portray a more academically challenged group of students transferring from CCs (either in-state or out-of- state) than either the non-CC transfer (4-year transfer) or the DHS to the CoE. This may explain in part, why the success rates are lower for CC transfers.

Based on our statistical analysis these students are able to increase their success by increasing their grades in Basic Program courses-either at the transfer institution or at ISU, and by increasing their overall transfer GPA. These students are also able to increase their success by increasing their first-fall and first-year GPA at ISU. In general, these students have a statistically significantly higher success rate if they achieve at least a B in the core engineering courses, and, once they begin at a CC, complete all of the math, chemistry, and physics courses before transfer. The highest-influence predictors of completing a BS in engineering for CC transfers were identified using a boosted logistic regression model. Included in these highest-influence predictors for the ISU CC transfer student are: first-spring university GPA and credit hours, CC transfer credits toward core engineering courses, first-fall credit hours after transfer, first-fall university GPA, and university core course GPA, all of which are significantly related to graduation in engineering.

One of the biggest challenges for the CC is identifying the students who are in a pre-engineering track. Prior to the SEEC project; pre-engineering students were identified post-admission by their course-taking patterns, such as enrollment in Engineering 100 or Calculus and Physics courses. Since the completion of the project, DMACC has developed a coordinated process to recruit, identify, and provide outreach to pre-engineering students beginning with admission to the CC.

Identifying CC transfer students from the perspective of the university can also be challenging. One of the challenges of this study was that multiple sources of data—from admissions, institutional research, and college sources—had to be combined to yield the required information. Disaggregating transfer student data presents a number of unique challenges since it has not been done before. In this study a transfer student is defined by the timing of their college credits rather than the number of college credits earned. One limitation of the data for this study is that the transfer institution listed is where they attended most recently and may not be the

school where the student had the most transfer credit. It is not unusual for a transfer student to bring credit from multiple institutions.

Conclusions

Since the inception of the project, DMACC and the ISU CoE have seen a notable increase in the number of pre-engineering students, the number of students enrolled in Engineering 100, the number of students participating in the E-APP learning community, the number of students transferring to the university, the number of transfer students participating in a LC at ISU, and an increase in first-year retention of DMACC and other Iowa CC students, especially those who participate in E-APP and other ISU LCs after transfer. This has ultimately led to an increase in the number of students graduating with an engineering degree from ISU.

The holistic approach of the SEEC project has enabled DMACC and ISU to leverage and support other outreach, scholarship, and retention programs, to reach out to elementary and secondary students with the messages of STEM; to encourage students to study engineering; to support those who identify themselves as pre engineering majors; to recommend successful navigation strategies that we found as a result of our research as well as support pre engineering students through the transfer process and incorporate them into a successful university experience including transfer LCs. In addition to E-APP; service learning, and experiential learning connects them to practicing engineers, and supports them academically through the challenging coursework required in engineering. The SEEC project enabled us to intentionally create successful and sustainable practices for transfer, raise awareness, and continue to expand the knowledge base of “what works” for recruitment, retention, and placement into engineering careers. By utilizing relevant research, using data for decision making, analyzing institution-specific student data to customize programs for maximum benefit to the student, and leveraging existing programs to enhance them and sustain innovations, SEEC goals were achieved through the creation of a transfer-friendly environment, a community of practice through partnerships, greater awareness about engineering and engineering careers, student-faculty interactions, and new datasets for research and evaluation. In addition, DMACC and ISU have developed extremely user-friendly electronic means of communicating information about transfer options for students as a result of the project (see Appendix).

Sustained outcomes: Transfer advising materials and websites

DMACC continues concerted efforts to communicate with, recruit, and advise students about entering the field of engineering, including: (1) Discover Engineering Day for HS students, whereby DMACC invited HS students to come to the DMACC Ankeny Campus and participate in a day of "discovering engineering." The students participated in hands-on engineering type activities, heard from engineers in the field, and listened to an education panel made up of DMACC and ISU faculty and strategy/activity. Students are invited if they are involved in a concurrent courses or Project Lead the Way; and (2) Explore Engineering Day for current

DMACC students, which includes research-based advice of connecting students with practicing engineers. In addition, DMACC has made numerous developments for STEM students, including establishing a new Associate of Science Degree (effective August 2014) for STEM majors seeking to transfer to earn a Bachelor's Degree and a Celebrate Innovation Week that immerses students and the general public in a variety of interactive projects to promote creative and innovative thought. The intent is to engage students (and the public) in a focused context outside of their normal studies (lives) to help them see both the value and process of innovation.

The project has developed and distributed various transfer advising materials and communications for and with CC stakeholders (see Appendix). It was intended to forge a collaborative trail for other institutions to follow and expand.

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Appendix

The following websites are maintained and utilized:

- The SEEC project website (http://www.eng.iastate.edu/seec/)
- College of Engineering transfer website: http://www.eng.iastate.edu/transfer/ Includes a new page with resources for Iowa community college students: http://www.engineering.iastate.edu/transfer/resources-for-iowa-communitycollege-students/
- The Pathway to STEM website, including the Transfer Student Guide, developed under a separate NSF project: www.pathway2stemdegree.org
- DMACC's Pre-engineering Advising Guide, https://go.dmacc.edu/programs/pdp/engineering/Pages/preengineeringames_boone.aspx
- A new resource was developed by the college's transfer coordinator as part of a masters degree project, the Iowa Community College Transfer Advising Manual: http://www.engineering.iastate.edu/transfer/files/2013/06/CC-Engineering-Transfer-Advising-Manual-SPR13.pdf
- Continued support and expansion of the pre-engineering program at DMACC: https://go.dmacc.edu/programs/pdp/engineering/Pages/welcome.aspx
- SEEC project has proposed a case study for the NAE's online CTC community, www.engineeringmessages.org, based on our STEP-funded work: http://www.engineeringmessages.org/TakeAction/TheCTCBlog/26051.aspx
- The following online examples of products were referenced:
    - Brochure developed for Iowa State University College of Engineering: http://www.eng.iastate.edu/seec/COERecruitmentBrochure.pdf
    - ISU COE Twitter page, an example of online content and social media using design/messaging elements of the original brochure: https://twitter.com/ISU_CoE
    - DMACC pre-engineering resource kit: https://go.dmacc.edu/programs/pdp/engineering/Pages/engineering-kit.aspx
- Engineering transfer learning communities are now available. Several were launched in relation to this STEP project. The list is maintained here: http://www.lc.iastate.edu/transferlc_index.html
    - New during 2012-13 was the Iowa Community College Transfer Advising Manual, which includes tips for student success that were a direct result of data collection and analysis from this STEP project. http://www.engineering.iastate.edu/transfer/files/2013/06/CC-Engineering-Transfer-Advising-Manual-
    - Established a new Associate of Science Degree (effective August 2014) for STEM majors seeking to transfer to earn a Bachelor's Degree.
    - **Websites created as a result of the SEEC project:**
        - http://go.dmacc.edu/programs/pdp/engineering/Pages/welcome.aspx
        - Brochure: http://go.dmacc.edu/programs/pdp/engineering/Documents/dmaccpreengineerigbrochure.pdf

- DMACC pre-engineering advising guide. Des Moines Area Community College.https://go.dmacc.edu/programs/pdp/engineering/Pages/preengineering-ames_boone.aspx
- DMACC developed an online Pre-Engineering Resource Kit https://go.dmacc.edu/programs/pdp/engineering/Pages/engineering-kit.aspx

Data Briefs

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Laugerman, M., Rover, D., Bruning, Laanan, F.S., M., Mickelson, S., Shelley, M., Laugerman, M., Darrow, M., & Pontius, J. Engineering transfer student—graduate profile. SEEC Data Brief No. 6. Ames, Iowa: Iowa State University. October 2011.

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Guides

Iowa community college transfer advising manual. Iowa State College of Engineering. Iowa State University.

DMACC preengineering advising guide. Des Moines Area Community College.